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BIG, BAD (?) DATA:

New approaches to the study of food, identity and landscape in early medieval England

By DAN STANSBIE[1] *and* SARAH MALLET[1]

Introduction

Food is essential to human biological and social reproduction, acting to transfer and transform flows of energy from communities of non-human plants and animals into human societies. The importance of food to human societies means that it is relevant to many areas that archaeologists might choose to research. The potential relevance of food research for archaeology extends to topics as diverse as trade and gift exchange, religion, demography and population expansion, transport and industry, migration, diet and the study of stable isotopes, as well as the landscape and identity. The topic of identity is of particular relevance to the study of the early medieval period in England because of the importance attached to identity in the development of this sub-discipline (Hadley and Richards 2000, Hills 2011). The study of identity in early medieval archaeology in England has traditionally been carried out through the analysis of material culture, but with a stronger focus on metalwork, architecture, settlement and cemeteries than on food. Food as a form of material culture, however, is well placed to contribute to the study of identity as it is produced and consumed by humans in locally specific ways. Food contributes to transforming human identity, educating the senses (Gosden 2005, 197) and shaping human bodies in particular ways. This importance of food to the practice of everyday life makes it an ideal source of evidence for the study of identity because it relates to local and regional identities and their transformation in ways not covered by other forms of material culture. Food is also dependent upon production in the landscape and therefore acts as a link between material culture studies on the one hand and landscape archaeology on the other. This paper is, therefore, an attempt to use food to understand emerging identities in early medieval England. As such, it brings together two on-going doctoral research projects (Stansbie in prep.; Mallet in prep.), both part of a larger 'Big Data' project, based at the University of Oxford and known as the EngLaId (English Landscapes and Identities) project (Donnelly *et al*. 2014; Gosden and Ten Harkel 2011). The paper comprises a brief literature review, followed by a discussion of methodological issues in the use of both large scale digital finds data and stable isotope datasets. Some initial and tentative results are then presented, followed by conclusions. This article is based on work in progress: its aim is therefore to discuss methodology rather than focus on substantive analysis.

A survey of literature on food in early medieval archaeology demonstrates that it is by no means a marginal topic. However, while the consensus view holds that food-ways probably did change considerably with the transition from Roman Britain to early medieval England, whether through migration or acculturation, no attempt has so far been made to undertake an holistic study of all categories of artefactual evidence relating to food, including isotopic data, drawing on both published and unpublished sources. The paper focuses on describing the development of a methodology for undertaking such a study using large amounts of digital, finds and contextual data stored on the servers of Oxford Archaeology (OA) and on the Archaeology Data Service (ADS) website and methodological issues in the analysis of large datasets.

The study of food in the early medieval archaeology of England

Food has been an important topic in early medieval archaeology and although it clearly does not have the kind of centrality accorded to buildings, settlement studies or funerary archaeology. There have been a number of important surveys on food in recent years including Hagen's (2006) survey of *Anglo-Saxon Food and Drink* and Banham's (2004) *Food and Drink in Anglo-Saxon England*. Hagen deals with food production, processing, distribution and consumption from the 5th century until the end of the 11th century and catalogues the major plant and animal species and their importance using historical and archaeological evidence. This work is a valuable resource, but little attempt is made to integrate the study of food into the wider study of early medieval society and identity. Similarly Banham's survey presents an empirical description of different Anglo-Saxon foodstuffs and their use without integrating the study of food into wider historical and archaeological contexts.

In contrast to the overviews just mentioned, Hamerow (2012) comments on the replacement of spelt wheat by bread wheat in the context of the transition from Roman Britain to early medieval England. She also discusses the introduction of new crops and changes in animal husbandry over the course of the early medieval period, commenting on the increasing diversity of crops including rye and legumes, and on the development of settlement nucleation and open fields as a consequence of the move to bread wheat, which she points out requires more frequent ploughing and more fertile soils (*ibid*., 149–62). Hamerow (*ibid*.) discerns fewer changes from the late Roman period in the composition of domestic

[1] University of Oxford.

animal herds, which are dominated by sheep and cattle, with game and possibly pigs representing higher status foods. Changes in the age profile and slaughter patterns of animals in the context of the developing complexity of social structures, urbanism and markets for land and meat are also discussed. While Hamerow integrates her interpretation of food remains into questions of agricultural continuity, settlement organization, and the development of more complex state and church social organization, food is not central to her work and she is forced to rely on a relatively small number of well published sites to draw her main conclusions.

Poole's research focused on animal bones, using assemblages to address questions of ethnic and gender identity (Poole 2008, 2013). Poole compared animal bones from urban assemblages inside and outside the Danelaw, finding little variation in the proportions of cattle, sheep/goat and pig consumed. He also looked at the role of animals in the construction of human identities, including status, religious and gender identities, observing that wild species and pigs are more frequent at elite and ecclesiastical sites than at rural and urban sites in the middle and late Anglo-Saxon periods and that fish and domestic birds were eaten at ecclesiastical sites during periods of fasting (Poole 2013, 64). Gendered differences in food consumption practices are difficult to identify in the early medieval archaeological record, but Poole argues that differences in nutrition and therefore diet may be observable in skeletal material belonging to the different sexes (*ibid*. 64–5). This conclusion suggests the potential significance of integrating isotopic analyses of human remains alongside broader studies of food based on faunal assemblages. Three chapters in the *Oxford Handbook of Anglo-Saxon England* (Hamerow *et al*. 2011) deal with wild animals, plant remains and animal husbandry in the period between the 5th and 11th centuries (Sykes 2011; Moffett 2011; O'Connor 2011). Sykes argues that wild animals were more common in the ecosystems of early Anglo-Saxon England, but less commonly exploited than in the middle and late Saxon periods when they began to be associated with elite power. Moffett's views on plant remains suggest that the commonly observed differences between rural assemblages of charred cereals and urban assemblages of waterlogged, fruits, nuts, herbs and vegetables are a function of taphonomy, with urban populations disposing of material in different ways to rural ones, but that more work may reveal regional differences in plant cultivation. Finally O'Connor presents data showing that cattle, sheep and pigs were the most common domesticates, but cautions against accepting quantification by NISP (number of identified specimens) at face value, as he argues that the method always overvalues cattle.

In addition to studies of faunal assemblages, there have also been a number of isotopic studies focusing on the early medieval period. Isotope analyses examine the relative isotope abundances of different elements in human tissues. The assumption behind isotopic analyses is that different environments, for example terrestrial and marine ecosystems or agricultural systems and/or foraging strategies relying on plants with different photosynthetic pathways (C_3 or C_4), will have a different isotopic signature, which will be passed to the foodstuffs produced or grown in these environments and then metabolized to the individual consuming these foods. Stable isotope ratios in body tissues therefore reflect those of the food they are derived from, allowing us to reconstruct the diet of the individual. The studies used for this paper focus on the carbon isotope ($\partial^{13}C$), which will reflect the ecosystem at the base of the food chain, and the nitrogen isotope ($\partial^{15}N$), which provides an indication of trophic levels (where an individual organism lies on the food chain).

An important study for the period considered is Müldner and Richards (2007) who conducted a large-scale isotopic analysis on human and faunal bone remains from different cemeteries in York. They concluded that the most important change in the period they consider (Roman to late medieval) is the introduction of significant amounts of marine protein, as evidenced by the increase in ^{15}N values. They explain this shift towards more positive values by the dietary restrictions imposed by Christianity, which could have resulted in an increase in fish consumption. This explanation is interesting, but considering we are dealing with a 'normal' urban population rather than a strictly monastic one, it seems unlikely that Christianity was the only factor influencing the diet: it is also possible that changes in agricultural practices should be taken into account.

A notable paper by Privat *et al*. (2002) analysed the isotopic values of both humans and animals from the early Anglo-Saxon cemetery of Berinsfield, Oxfordshire. The authors attempted to characterize the dietary patterns of sub-groups within the community buried at the site. They do show evidence of significant dietary variability between groups differentiated on the basis of age and wealth, most notably between richer and poorer burials (as determined by the ranking of grave goods) and between younger and older males. Interestingly, there does not seem to be any difference between the female and the male diet, at least in this dataset, which is not necessarily representative of the whole early medieval period

In summary, although an increasing number of important works pertaining to the study of food in early medieval England exist based on a number of different categories of data, more work remains to be done to integrate the different datasets. Moreover, broader issues including the relationships between food and the early medieval landscape, and food and identity are still under-explored. The remainder of this paper begins to address these issues by discussing the problems and pitfalls of using an integrated methodology for a holistic analysis of food, landscape and identity in early medieval England.

Methodology

Scope

The area of the EngLaId project is very large, encompassing all of the landmass within the boundaries of modern England. For Stansbie's project, which studies ceramics, faunal assemblages and charred plant remains from the middle Bronze Age to the early medieval period (*c*. 1500 BC–AD 1086), it has therefore been necessary to select geographically restricted case studies within England, in order to fit the work within the scope of a PhD thesis. The areas so far selected are the Upper

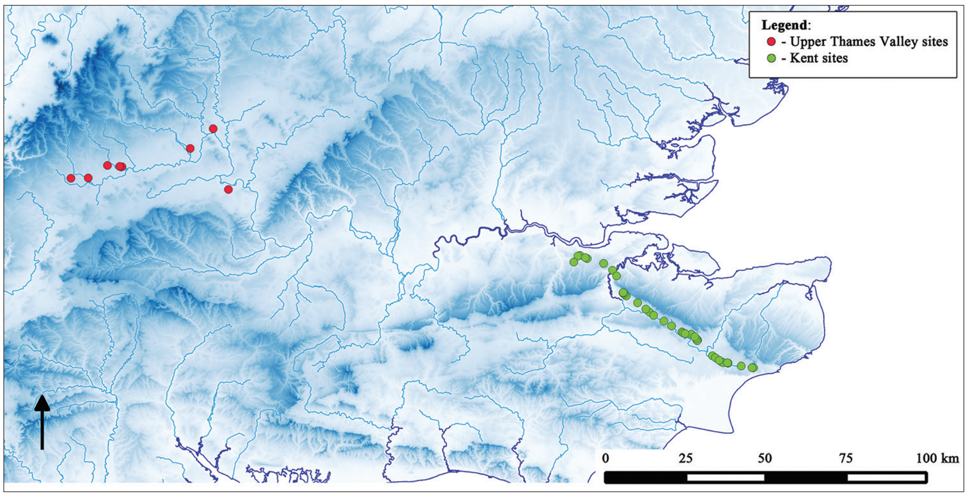

Figure 1 Distribution of sites by case study.

Thames Valley in central and western England and the route of the High Speed One (HS1) railway in Kent (Fig. 1). The case studies were selected for two main reasons. Firstly, both areas have been intensively excavated and surveyed since at least the mid-20th century, partly as a result of work stemming from the implementation of Planning Policy Guidance Note 16 (PPG16). Secondly, the locations, landscape and archaeological sequences of both regions are sufficiently different that we can expect interesting results from a comparison of the two. The Upper Thames Valley is geographically central, but also relatively isolated; its archaeological sequence indicates a strong degree of long-term continuity in settlement location and a lack of development of high-status sites in many periods. HS1 on the other hand is located in a coastal region, with a long history of contacts with the continent and a high level of diversity in its archaeological sequence.

Mallet's approach to the same time period is somewhat different, encompassing a large-scale isotopic study based predominantly on existing data. Due to the relative scarcity of existing isotopic data (as opposed to pottery or animal bone), geographical zones have not been delimited. In fact, because the data is already heavily biased toward the Thames Valley and Yorkshire, it was felt that further sub-divisions would be unproductive. Instead the decision to work on the sites presented here can be explained by the challenges inherent to isotopic multi-site analyses. One of the first – and most important – difficulties encountered was how to compare sites from different environments. It has long been accepted that isotopic variations seen in human remains can be the result of changes in the environment (whether changes in micro-climate or changes in human agricultural practices) rather than changes in diet and that we must be careful to differentiate between variations caused by differences in diet and variations caused by differences in environmental factors. To conduct a dietary comparison that is both valid and significant, we must therefore make sure that we measure the diet signal and not environmental 'background noise'. In order to do this it is necessary to construct an environmental baseline for each site (because the isotopic values one analyses are not absolute but relative). We will then be able to compare the human values against this baseline, and by measuring and comparing how much the human values differ from the 'environment' we will thus be able to assess the diet more clearly. Therefore, sites were primarily chosen for the quality of the animal data present in order to create solid baselines.

At this stage of research, data has been collected from peer-reviewed papers and unpublished doctoral theses. Each site was briefly analyzed on its own in order to establish general patterns. It is known that environmental variations in ^{13}C and ^{15}N at the base of the food chain (i.e. plants) find their way up to the human consumers via the herbivorous animals. It is often assumed that animals' diets do not vary within species and that most animals would have been herded locally by the population managing them, thus making their isotopic values an acceptable proxy for the local vegetation (Sealy 2001). By averaging the values of each herbivorous species at each site, and then by averaging the values of humans at the same site and comparing both averages against each other, it is possible to see how much the human values vary from the baseline by looking at the offset between the baseline and the humans' values. It is then possible to look at the variations of the different human populations considered by comparing the different offsets. This approach is not without its problems: there is a definite bias in the dataset towards larger animals whose bones are more likely to have survived (although this is not strictly true of pig bones, cf. Hull 2007) and the prevalence of these animals in the archaeological record might be due to an archaeological recovery bias rather than human dietary preferences (Hull 2007).

The nature of the data

The logistics of analyzing any kind of data on a large-scale demand that the data must either already exist in a digital format or be digitized during the course of research. Data of the first kind, while relatively easy to upload into a database, comes ready formatted in ways that may not necessarily be compatible with the kinds of analysis required; the second type of data can be formatted to suit the requirements of the project, but can be time consuming to produce. EngLaId was set up as a 'Big Data' project, so the data used are mostly of the first type, as a high volume of data is considered necessary and time for data entry is therefore limited.

This reliance on pre-existing digital data has created a number of problems that will become clear below (also see Donnelly *et al*. 2014).

Data collected for Stansbie's project consisted of nine main types, largely existing as spreadsheets in Excel or .csv format: context catalogues, ceramics catalogues, animal bone catalogues, charred and waterlogged plant remains catalogues and small finds catalogues. Worked stone, ceramic building materials and fired clay catalogues were also accessed and some data was entered from paper context records held at Oxford Archaeology. Mallet's project involved a large-scale synthesis of existing isotopic data from published and unpublished sources, and will also include a limited number of newly created measurements.

Data storage

The question of data storage and accessibility following completion of research projects is of increasing concern in archaeological research. The data used in Stansbie's project is therefore stored in a single FileMaker database (Fig. 2), comprising a series of linked tables which record information on site type and location, context and phasing, ceramics, animal bone, charred and waterlogged plant remains, fired clay objects, ceramic building materials, worked stone and metalwork. This database is designed to be able to draw together information from the different categories into tables of quantifiable food-related data detailing specific time-periods, regions, site types and individual sites.

One of the contributions of Mallet's project will be the creation of a comprehensive isotope database that will contain all of the results from isotopic studies on English material. As much information as possible about each of the samples used in this thesis will be included, making it a more extensive database than we usually have for isotope studies. For previously published material, the database includes the publication of the paper as well as the author and place of publication, allowing any of its potential users to easily find the source material (it is intended that the isotope database will be deposited with the Archaeology Data Service (http://archaeologydataservice.ac.uk) following completion of the research). The isotope database contains both human and animal datasets: animals' isotope values are used as a baseline against which we can compare humans and are thus essential to the isotopic analyses. The human samples cannot be understood without the animal ones: separating the animal from the human dataset is undesirable.

Basic information, such as species, sex and age are essential to the isotopic analyses and are also represented in the dataset: looking at how isotope values can change and evolve across time-periods or regions between different sub-groups, as defined by gender or status, can give us insights into the social organization of a society. Age differentiation serves the same purpose as gender differentiation. However, unlike gender, it is more difficult to assess categories, especially considering that past societies might have different attitudes to age and that an adolescent might have been considered as a child or an adult depending on the period.

However, the isotope database is unfortunately not as complete as one might have hoped. The presence or absence of grave goods or other burial information is often missing, which is regrettable as a systematic large-scale study of grave goods in relation to the isotopic values of the individual buried is long overdue. Another issue that might be raised is that different bones were sampled: the shift from diet-to-collagen may vary depending on the rates of bone turnovers and there might be a significant difference between values from ribs or femora. However, at this stage, the information sampled is far from complete and cannot be comprehensively shown in the database.

The chronological resolution of the isotope database is currently very broad, dividing samples according to whether they are considered early, middle or late Saxon. However, even this broad-scale analysis has not been previously attempted at a comprehensive nationwide level. Future work will develop a more refined chronology, looking at changes and continuities within these broad periods.

Problems with data analysis

Problems with data analysis flow from the nature of the data. There are three main linked problems (described below). The first derives from the dispersal of the data across different data repositories, the second derives from its differentiated nature and the third derives from its incompleteness. Data is time consuming to locate, with data from a single project being stored both on and offline. Obtaining data can involve searching through hundreds of digital files stored in several different places on the servers of a single organization. For example, digital data held by Oxford Archaeology is archived in several different locations on the company's servers, depending on both when it was created and the developer-funded project to which it relates. Different datasets relating to the same project are sometimes distributed across different servers. For example, data created during excavations in advance of HS1 is held in the archaeology data service (ADS) online repository, but some detailed finds catalogues are more easily accessible from the project server at Oxford Archaeology. This in turn contains detailed ceramics catalogues for all HS1 sites but detailed animal bone catalogues only for those sites excavated by Oxford Archaeology. It must be emphasized that this dispersal of data is not the fault of any one organization, but relates to the fact that data management and understanding of how to prepare data for digital archiving within archaeology is still in its infancy. Furthermore technologies for capturing, analyzing and disseminating information are constantly developing in an under-resourced sector. However, the existence of these problems highlights the need for the implementation of already existing standards for data description and digital archiving within British archaeology if the sector is to benefit from 'Big Data' projects in the future.

Even more serious problems relate to differentiation and incompleteness, which generate large areas of incompatibility in the data from different sites. In order to collate data on different artefact types from different sites it is necessary that each data table uses the same terminology to describe phases of activity. However, at the time of writing there are 256 different terms for describing chronological phases in use in Stansbie's database, and this problem is mirrored and amplified in the tables containing finds information. The problem of incompleteness compounds this issue, meaning that many contexts and finds do not come with any phasing data attached. A further problem is that phasing data contained in context tables is sometimes contradicted by phasing data for the same contexts held in finds tables.

The differentiation of the data relates mostly to recording methods and procedures, which vary according to archaeological organizations, specialist sub-disciplines and between individual specialists. The least amount of variation is encountered in the recording of context information, for which something approaching an industry standard exists. Context catalogues are therefore relatively easy to incorporate into a single data set without excessive modification. When attempting to use finds catalogues, however, the situation is entirely different, with most ceramics specialists working within the commercial, government, and academic sectors recording subtly different aspects of their material, quantifying it in different ways and using a wide variety of sometimes idiosyncratic alpha-numeric codes to describe it. For, example the dataset collected for Stansbie's project at the time of writing incorporates 457 different codes for basic ceramic vessel forms, relating to whether a vessel is, for example, a jar, bowl, or flagon, derived from work carried out by four organizations. Data cataloging protocols for other categories of find are equally complex (with the partial exception of animal bone: whilst the cataloging of species is fairly standardized, codes used for other aspects such as butchery can be very varied). The situation is compounded by a general lack of metadata for detailed finds recording.

The incompleteness of the data is a more straightforward matter. Digital files containing context catalogues, for example, or animal bone records sometimes lack data on phasing, descriptions of soil types, or information on certain kinds of butchery practice. While this is a simpler problem it is just as serious for data analysis as data dispersal and differentiation.

Attempts to clean up and resolve these problems with the data have so far focused on creating compatibility in the phasing information contained in the database. This has meant creating a list of standardized phase descriptions into which the two hundred different existing phase descriptions could be translated by way of a linking table. Data on, for example, animal bones can now be queried with standardized phasing across all the sites in the database for those contexts with phasing. However, large numbers of contexts within the database do not have phases assigned.

Results

Although this paper is primarily methodological in nature and analysis is still ongoing, the following is intended as a brief indication of the broad parameters and possibilities of our databases, combining animal bones – a category of data which in many ways is the most internally consistent and compatible across different sites due to the use of the relatively standardized criteria for classifying animal bone species by specialists – and isotopic data. The animal bone data comprises material

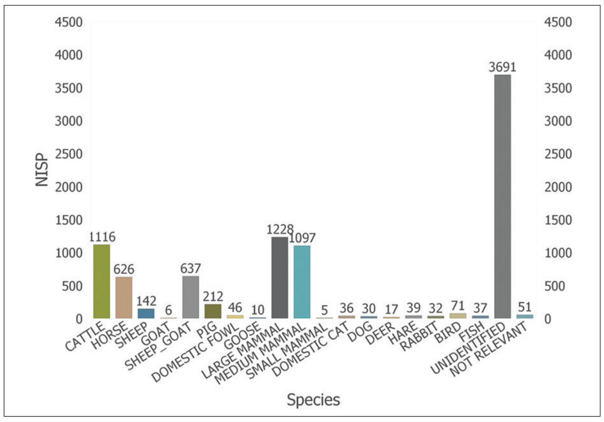

Figure 2 Late Roman and early medieval animal bone from the Upper Thames Valley and the route of HS1 by NISP, excluding unphased material.

from two sites in the Upper Thames Valley and fourteen sites from the route of High Speed 1 in Kent. The data is expressed in the form of a series of bar charts showing the prevalence of different species across time by phase. Figure 2 shows the quantity of late Roman and early medieval animal bones of all species from both the Upper Thames Valley and the Kentish case studies measured by number of identified specimens (NISP) and excluding undated material. The late Roman to early medieval period is envisaged as running roughly from AD 240–AD 1066. MNI (minimum number of individuals) data is not used, as it is not available for all sites. The assemblage is dominated by the larger domestic species particularly cattle, but with significant quantities of sheep/goat and horse. Pigs make a less significant contribution. Taken together large, medium and small mammals and unidentified species make a significant contribution. Domestic fowl and wild species make very small contributions. Figures 3 and 4 show the same assemblage divided by region. Several differences between the two assemblages are immediately apparent: firstly, the overall quantities of material from the two Upper Thames Valley sites are far greater than those from the 14 Kentish sites. Secondly, the make up of the Kentish assemblage is very different to that of the Upper Thames Valley assemblage, with cattle bone contributing relatively little to the Kentish assemblage compared to horse and with bird bone, for example, contributing more than pig. In contrast the Upper Thames Valley assemblage appears much more conventional, being dominated by cattle and sheep/goat. It should not be thought, however, that these results represent genuine patterns of animal bone distribution. The Kentish results in particular are clearly distorted by the fact that very few contexts from the Kentish part of the data have been assigned phases, so that when all the animal bone data from HS1 is plotted regardless of phase the assemblage is very heavily dominated by undated material. Despite the clear limitations of the data it is hoped that these results have illustrated something of the potential of our databases for the analysis of consumption patterns on a large scale. For example, the broad pattern extrapolated from the faunal remains suggest that cattle and sheep were the dominant meat animal, with pigs and horses

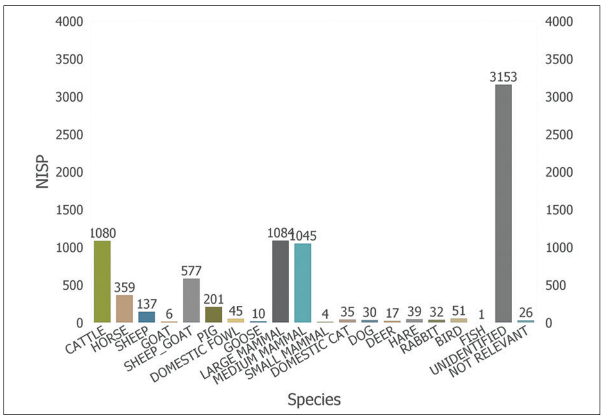

Figure 3   Late Roman and early medieval animal bone from the Upper Thames Valley.

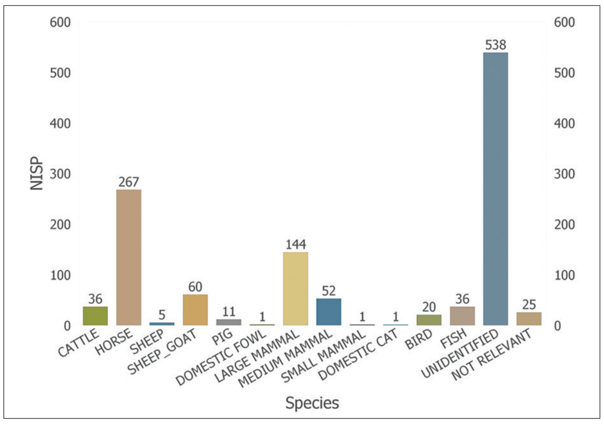

Figure 4   Late Roman and early medieval animal bone from the route of HS1.

also playing an important role and this seems to be backed up by the results of isotopic analysis (see below). However, such assertions need to be backed up by further analyses, to which it is hoped the methodologies outlined above and the data collected so far will make a significant contribution.

The isotopic data for the Anglo-Saxon period – analysed on a country-wide level, in as far as data are available – is indicative of a C_3 terrestrial diet, with a possibility that freshwater resources were consumed (Müldner and Richards 2007). The human ∂^{15}N values are enriched compared to the herbivore baseline, showing that animal protein was consumed on a regular basis (Chenery *et al*. 2010). Some individuals have ∂^{15}N values which are enriched to up to two trophic levels compared to the herbivore baseline, which might indicate aquatic protein consumption if the ^{13}C values were more positive (Fig. 5). This combination of low ^{13}C and high ^{15}N (relative to the baseline) must lead us to consider the dietary input from omnivorous animals, whose ^{15}N would be elevated whereas their ^{13}C values would remain comparable to those of the herbivores. According to both archaeological and textual evidence, pigs and poultry are the more likely candidate. On average, pigs have similar carbon values to herbivores, but are enriched in ∂^{15}N by 2‰. Preliminary studies suggest that, according to the written evidence, pork consumption in the early medieval period was second only to beef and pigs fed on meat products would have had elevated ∂^{15}N values compared to grass-fed cattle, which in turn could have been passed on up to the humans and could explain the high ^{15}N and low ^{13}C (Müldner and Richards 2007). A complete review of written evidence on early medieval diet will be undertaken to assess the value of the isotope results in light of food practices in the early medieval period as described by contemporary writers.

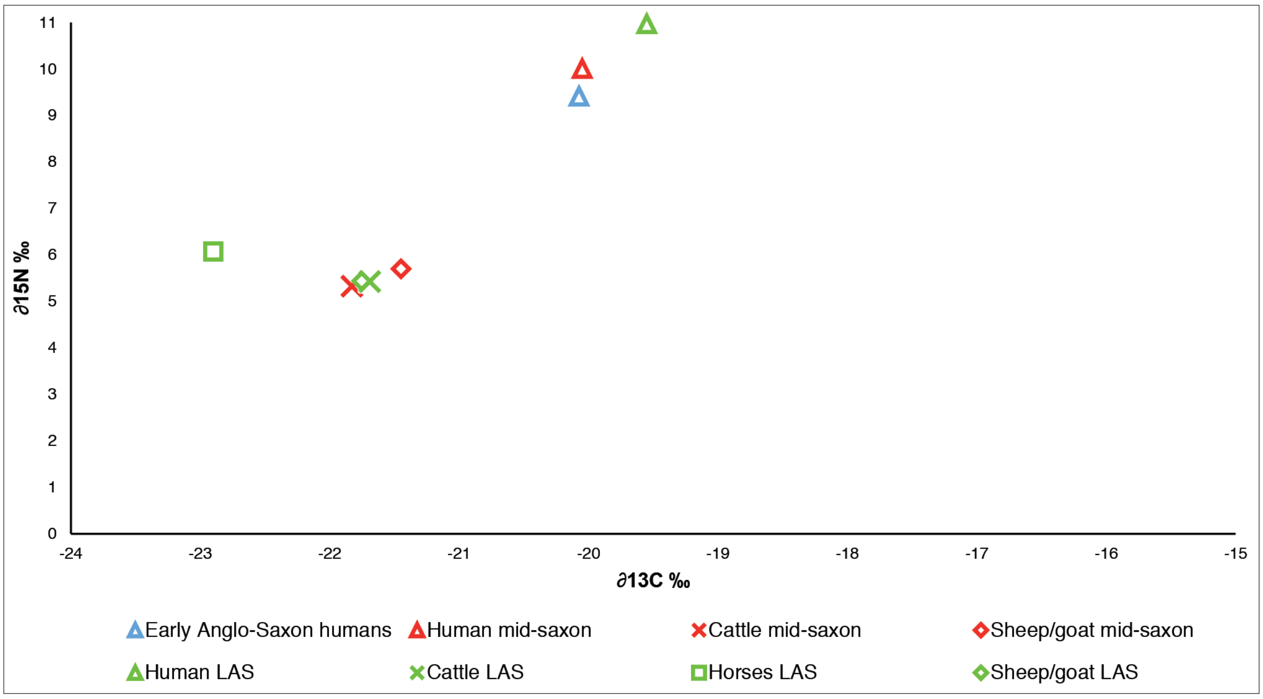

Figure 5   Anglo-Saxon isotopic data.

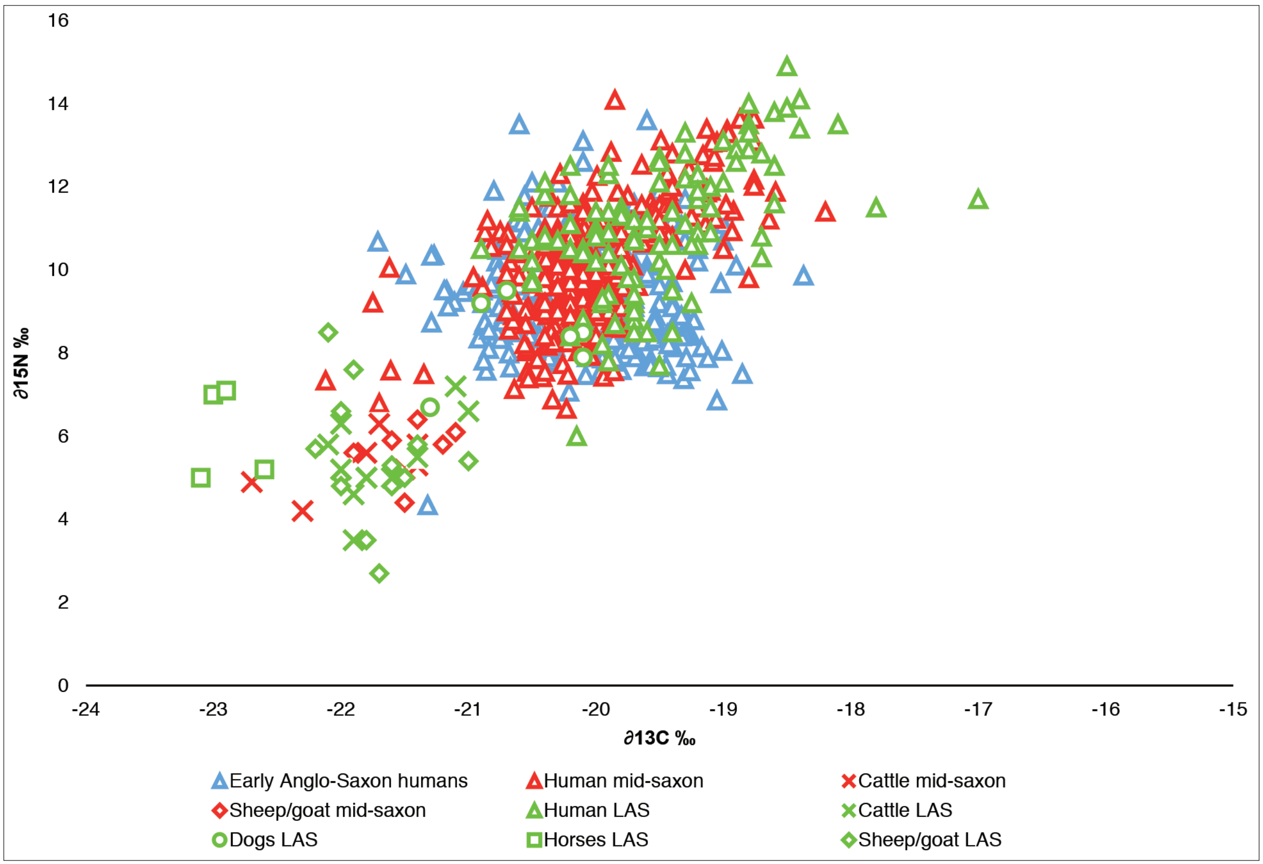

Figure 6 *Anglo-Saxon isotopic averages.*

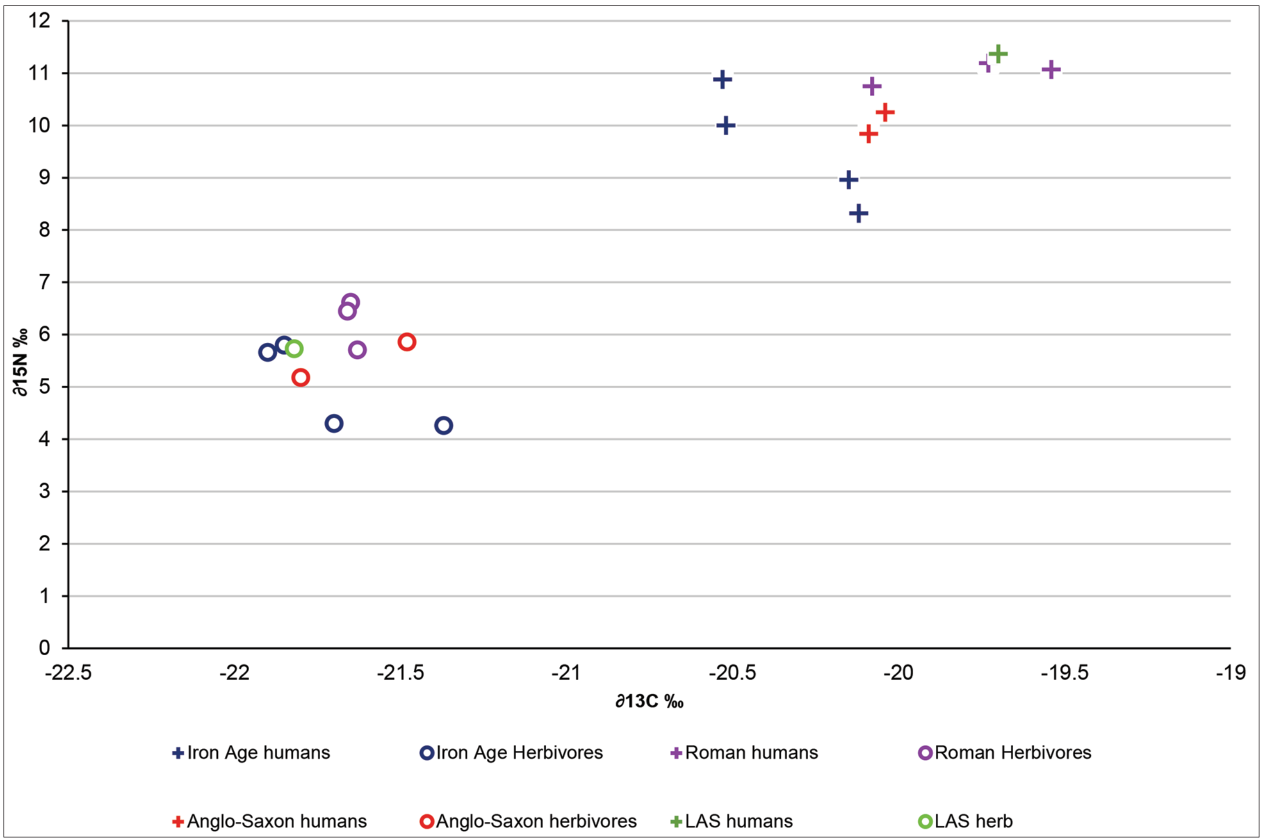

Figure 7 *Comparative isotopic results between the early medieval, Iron Age and Roman periods.*

There is no significant difference between the different groups despite some indication of a correlation between male diet and status at Berinsfield in Oxfordshire (Privat *et al*. 2002). The wealthier individuals, identified on the basis of their grave goods, seem to have lower ^{15}N than the poorer individuals (Privat *et al*. 2002). This is interesting because higher ^{15}N is usually interpreted as a sign of higher status, as it is believed to indicate that higher quantities of meat are being consumed. However, if the correlation between ^{15}N enrichment and lower social status is attested for other sites, we might need to look at other causes of high ^{15}N, such as the consumption of freshwater fish, omnivorous mammals or younger animals in a herd.

When comparing the Roman period and the early medieval period, it is striking that the early medieval isotopic values are depleted in both ^{15}N and ^{13}C and closer to the Iron Age values (Fig. 6). However, looking at the offset between the human and the environmental baseline, it is immediately obvious that the ^{15}N offset remains similar to both the Iron Age and the Roman period values (Fig. 7). Once again, it is the carbon that is worth investigating, as the offset between the values of the humans and the herbivores is smaller than it was during the Roman period. If we accept that the Roman ^{13}C values were enriched because of the consumption of marine protein, then the shift towards more negative values could most easily be explained by the abandonment of fish consumption, at least in the early Anglo-Saxon period. However, although we do not yet have enough data to be confident, there is a hint at an increased consumption of fish throughout the early medieval period. The earliest Anglo-Saxon site examined, Berinsfield (AD 450–700), has the lowest values in both ^{13}C and ^{15}N of the early medieval data. There is then an increase in the middle Saxon period, which we can see in the data from York. This enrichment culminates in the late Anglo-Saxon/Norman period with the highest values in ^{13}C and ^{15}N of all the dataset (including the Roman values). It is impossible to tell at this stage if the differences between early and middle Saxon is actually a difference between small site (Berinsfield) and important urban centre (York) but when considering it in conjunction with the later Saxon data, it seems to point towards a chronological trend.

Conclusions

This article aims to point the way towards a methodology for using the large amounts of published and unpublished digital data generated by commercial archaeologists to give new insights into the transition from late Roman to early medieval foods. The data relevant to this topic are highly variable both in quality and consistency and they are difficult to access and even more difficult to analyze. However, the data have tremendous potential to alter our understandings of early medieval societies across a wide range of topics, including the use of landscape in food production. The initial results of both projects seem to support the already widely accepted idea that cattle and sheep were the dominant meat animals in the late Roman to early medieval periods and that pigs also made an important contribution. On the face of things these results seem to be telling us what we already know. However, for a series of methodological reasons outlined above, our analysis only really scratches the surface of the available data and our results could therefore be misleading. Issues that need to be resolved include the standardization of ceramic, faunal and chronological data in our databases and the chronological issues with the isotope data. 'Big Data' techniques applied to the developer-funded data have a lot of potential to transform our understanding of food in the late Roman to early medieval period. The realization of this potential does, however, require several things. Firstly more data is needed, as although the quantity of data collected is large, it still represents a very small fraction of everything that is available. Secondly, much more work is required on methods of analyzing the data, specifically in making data drawn from different sources compatible in terms of basic description. Finally, many more categories of data need to be drawn into the analysis, as only those approaches that encompass all surviving data categories can provide a meaningful representation of past societies. It is hoped that the development of an holistic approach to food using large-scale commercially produced data will enable deeper and more nuanced understandings of Anglo-Saxon food, and the relationships between people and the landscapes they inhabited.

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